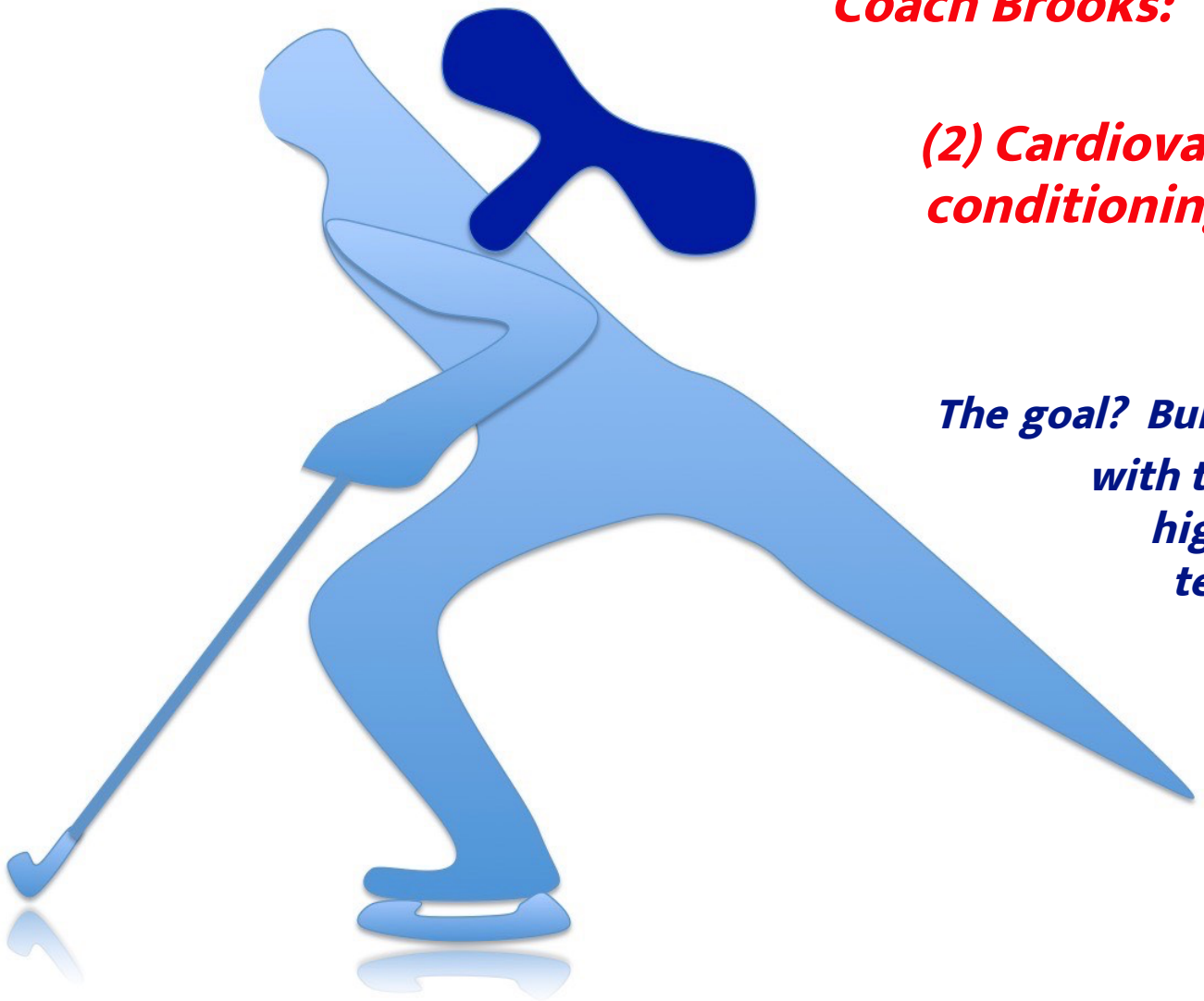
There's Conditioning ...

and there's Conditioning

The Dual Meaning of 'Conditioning'

(1) Neurological conditioning <=> habits.
Coach Brooks: "Play your game!"

(2) Cardiovascular-metabolic conditioning is a by-product



The goal? Build wind-up machines
with the stamina to repeat high speed, quality skill, tenacious defense, and gritty toughness every shift of the fastest games

Hockey Conditioning

For decades, 'conditioning' has been defined by academic language: 'cardiovascular-respiratory, aerobic, anaerobic metabolism' etc.' Each concept was taught in its own separate lecture; and this led to naive attempts to separate them in training.

Forget the lecture-language ...

Hockey conditioning
prepares teams to maintain the qualities
needed to win the most intense playoff games.

For children & adolescents ...

slow training is not part of the development plan

So, how do we accomplish this?

HIIT = High Intensity Interval Training

Why do so many athletes train slowly when their goal is to play fast?
We sports scientists – unwisely – advised them to train aerobically,
corralling them into slow academic boxes – and called it 'cardio.'





To young players: Getting faster is among your highest priorities.

Slow 'cardio' endurance training is practicing slowness. It requires time and energy that could be invested in High intensity intervals for speed and skill.
So, what about the health and competitive benefits of aerobic fitness?

The good news …

High intensity intervals for speed can also improve fitness sooner – and to a greater extent than slow cardio

Speed-endurance for Gold Medals & Youth Development

Three USA Teams trained together for more than five months prior to their respective Olympics: the 1980 men and 1998, 2018 women. They emphasized fast conditioning and won Gold, finishing each game executing skills at the same pace as at the beginning.

The 2026 wins by team USA women and men — while highly significant — are not part of this story of preparing a team for months. They were together for only a few days.

Many other factors enter into wins, of course, but speed-endurance is one that can be planned, executed, and improved.

Repetitions result in cellular changes to nerve pathways. If you repeat slow movement (such as jogging) or if you skate while fatigued, the inefficient mechanics become part of your nervous system memory bank.

The unbending law of neuro-science:
You become what you repeat often,
so
Don't train slowly when your goal is to play fast.

To develop speed-endurance, the Gold-Medal teams first asked this question:

Knowing we want to practice skills at an uncomfortably-fast pace, does this also improve aerobic-cardiovascular fitness without slow aerobic training?

Short answer: YES. High Intensity Interval Training (HIIT) increases aerobic-CV fitness, plus explosive qualities required to even think about a gold medal: speed, skill, strength.

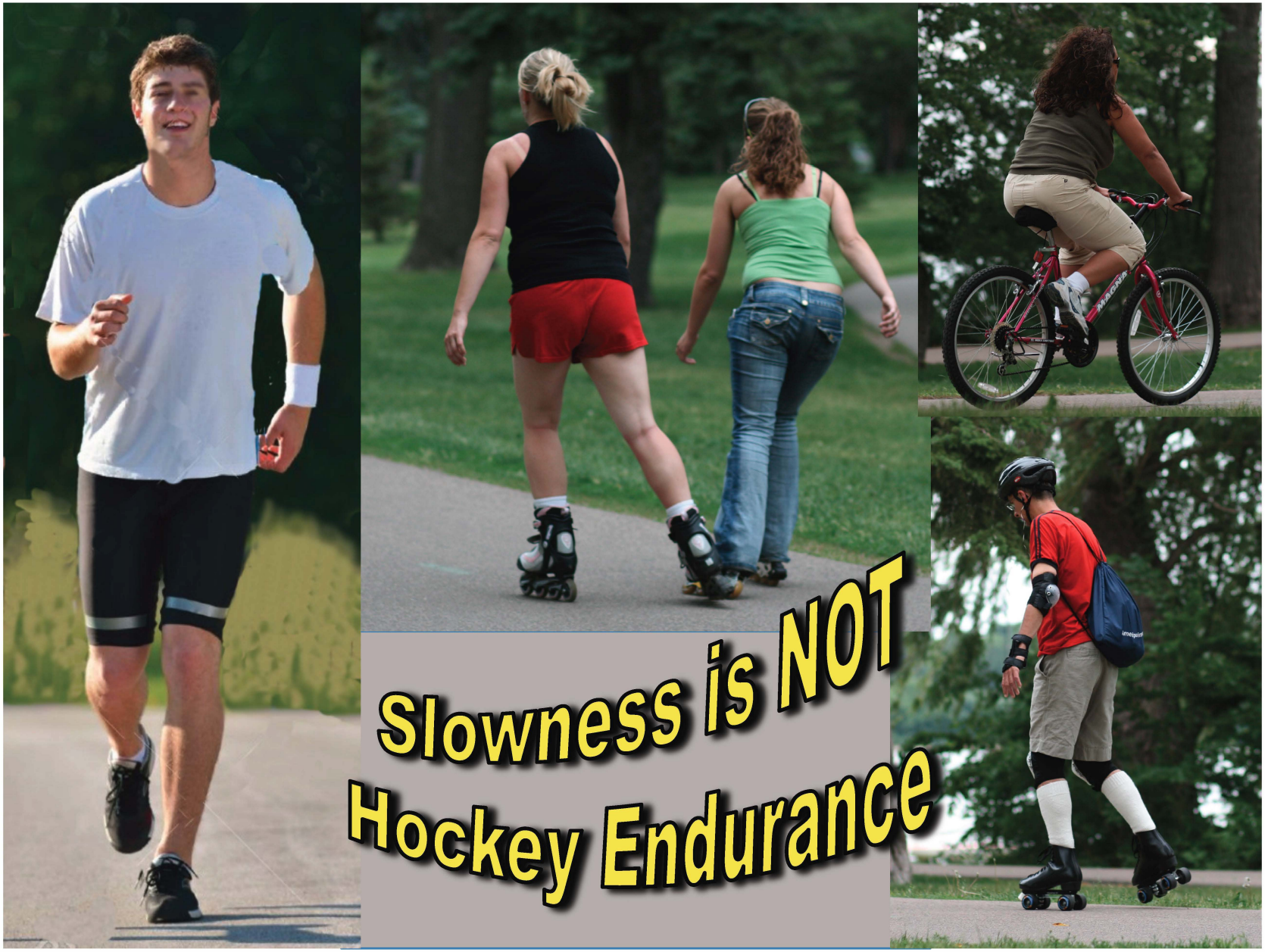
***Speed-skill-endurance** by the 2018 U.S. Women's team was the specific goal of every workout on and off the ice for two+ years. Coaches Robb Stauber, Brett Strot, and Paul Mara kept the pedal to the floor, knowing the Canadian women were big, fast, strong, skillful and competitive. Canada had won Gold four times since Ben Smith's team USA won the inaugural women's Olympic hockey competition in 1998.*

***And the 1980 'Miracle on Ice'** was no miracle at all. It was the result of relentless preparation. Team skills were repeated for two-hour practices at uncomfortably fast pace for six months. Nothing slow, or the wrath of Coach Brooks was unleashed, resulting in the dreaded 'Herbies' – stops-and-starts, skating the lines.*

*note: **Punishment skating is counterproductive at young ages when skating habits are formed!***

Did these USA teams dominate? Of course not. That was never considered a possibility. But in 1980 the speed-skill attack by the Soviets was not allowed to take over the game as it did against other competitors for forty years.

OverSpeed (uncomfortably fast) preparation made these Gold Medalists comfortable (defensively and offensively) with the elevated pace of play against the top teams in the world, every shift of each game.


Slowness is NOT
Hockey Endurance


Hockey
endurance
Have It
Your Way!



Endurance repetitions and CNS memory can NOT be separated …

so the highest priority?

Quality repetitions


Endurance
Intervals
15:45
Practice
Knee bend
and WIDE
strides
Hockey
endurance
Plus Good
Skating habits



Of what value is cardiovascular fitness … if you can't skate with good knee bend near the end of a shift or game?

Rem Pitlick a peewee on the slide board – now a professional in the AHL & NHL

High Intensity Interval Training

HIIT workouts improve both Explosiveness & Endurance

Skating and off-ice Power and Endurance improved significantly in a six-week college pre-season dryland study using HIIT training exclusively.

Similar results were observed in other interval studies *(Fox EL 1974, 1981; McArdle WD 2001; Torma F 2019; Brooks GA 2020).*

Read more: HIIT is the subject of many recent research studies and opinions in peer-reviewed journals and A.I.

It's time to bury the myth that strength, speed, and endurance must be separated, when games require ALL these qualities in the same shift.





High intensity interval Training improves both explosiveness and endurance in the same workout.

Slow Aerobic training does not improve explosiveness.

Data:

Energy expenditure & Heart rates during explosive off-ice interval workout:

(average of 5 professionals)
Total calories burned in 70 minutes: 1250 cal.
(estimate from HR monitor)
Each work interval produced HRs > 94%.

Rest interval HRs did not drop below 75%.

On-ice overspeed interval training:

(same 5 professionals)

Total calories burned in 70 minutes: 1070 cal.
Each interval HRs>92%.
Rest intervals: HRs always >70%

Is Lactate a metabolic poison?

No. Lactate is an important fuel during hockey games, and fast interval training prepares the body to recycle it more efficiently.

Note: The end product of glycolysis (the breakdown of Glucose) is Lactic Acid (and pyruvate to a lesser extent). Lactic acid splits almost entirely in the muscle's water into Lactate$^-$ and Hydrogen (H^+) ions.

It is not my intention throughout this book to duplicate the volumes *written about the biochemistry-physiology of exercise. We'll discuss Lactate metabolism, because it is often misrepresented or left out of discussions, and is super-important for hockey.* ***Feel free to skip paragraphs (1-5).***

To review some of the metabolic factors that are commonly discussed, look up the following topics in Khan Academy videos or Google. Focus on the bottom line, the beginning and end of a metabolic pathway, not the names of enzymes.

1) *Compare Type-II Fast-twitch muscle fibers (FT) to Type-1 Slow-Twitch (ST) fibers. FT fibers are the light-colored ones (like the white meat of a turkey) that contract-relax faster and more powerfully. They don't have the endurance of the reddish ST fibers. Near maximum effort is essential to recruit FT fibers to improve speed, strength, and explosive acceleration. Appropriate interval training at young ages can increase blood supply and enzymes for improved endurance in FT fibers, giving them the best characteristics (endurance and explosiveness) of both ST and FT fibers.*
2) *Adenosine-tri-phosphate (ATP) supplies energy for muscle contraction (and for other cell functions in the body). It is the 'cleaving off' of the 'third' phosphate from ATP, that provides energy. This leaves ADP (…-di-phosphate) and AMP (mono-P), which must be re-converted to ATP by various metabolic pathways (below).*
3) *Breakdown of fuels. Look up 'fatty acid or protein catabolism,' glycogenolysis, glycolysis, the Krebs cycle, electron transport chain. Don't be distracted by details. Just understand the beginning and end of each part – the significance of that part in energy supply.*
4) *Some ways inorganic phosphate (PO_4^{3-}) is added to ADP to return it to its high energy state, ATP: (a) For short bursts of exercise, like sprints or jumps or lifts, Creatine Phosphate (stored in the muscle) donates it's phosphate to ADP. (b) Glycogenolysis is the breakdown of Glycogen (carbohydrate stored in muscle) to Glucose; then Glycolysis is the catabolism of Glucose to Pyruvate or lactate for (c) Aerobic metabolism of pyruvate or lactate in the mitochondria (see Khan Academy for video details of the Krebs cycle and the electron transport chain). (d) Fat or protein catabolism generates energy aerobically, the final steps similar to those for Glucose. The fate of Lactate will be discussed on the next page. Given the intermittent nature of hockey, it is like no other sport in terms of energy metabolism.*

5) *Hydrogen ions (H^+) are simply protons split off from Lactic Acid. They would increase the acidity of blood dangerously if not for the buffering system, in which bicarbonate (HCO_3^-) already in the blood combines with (H^+), and through chemical reactions (H_2CO_3 is an intermediate) eventually produces Carbon dioxide which speeds up breathing and is exhaled with each breath. The effectiveness of this buffering system at high workloads is one of many ways to delay fatigue.*

Lactate metabolism is an important factor in 'hockey conditioning.'

An adaptation that is often left out of the discussion, is the productive use of Lactate for energy with increased training **intensity**. For rather technical reviews, G.A. Brooks *(2009, 2024),* and Gladden *(2004,2008)* have discussed the history and evolving perspectives on blood and muscle lactate held by physiologists over the past century. Because high levels of lactate exist in the blood as exercise intensity increases, it was incorrectly assumed that lactate was the cause of fatigue. This was no more correct than to assume high heart rates cause fatigue, simply because HRs are high. It is not uncommon to hear fitness gurus speak of distinct aerobic or anaerobic levels of work. This is a misnomer.

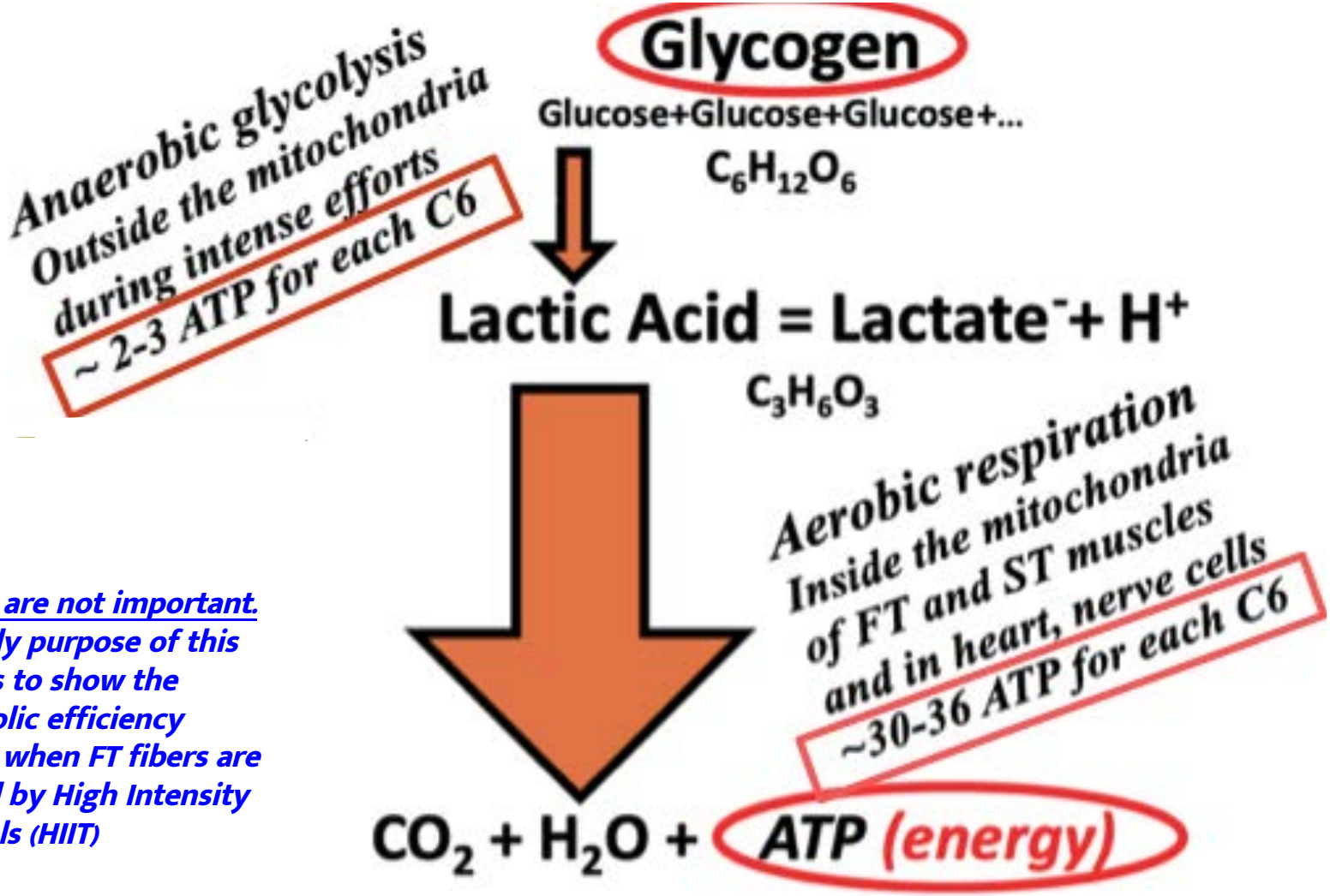
Both types of metabolism occur – to different extents – at every workload. Aerobic metabolism doesn't end at a certain high intensity, and certainly slow-twitch muscle fibers do NOT just take a break when a person is exercising at these highest levels. All hands are on deck, of course when workloads are near maximum. High-intensity exercise, given the pseudonym 'anaerobic work,' occurs every shift of a hockey game; yet oxygen utilization might reach a maximum. All muscle fibers (Type-1, Type-2, and adapted Type-2 oxidative fibers in between) are presumably operating near capacity when effort reaches maximum.

More recently, with modern (radioactive tracer) technology, it has been shown that lactate can be: (1) a fuel in muscle cells that produced it anaerobically if they have sufficient mitochondrial enzymes, (2) shuttled in the blood to other cells like slow-twitch muscle (Type-1), and to nerve, glial, liver, brain, and heart muscle cells; (*Brooks,2009; Gladden,2008; Rogatzki,2015)*, **or**, (3) converted back to Glucose in the liver (Cori-cycle) *(Brooks,2009; Gladden,2004)*.

Hockey endurance is dependent to a great extent on how efficiently we can recycle Lactate aerobically. The more skating-specific interval training we do, the better equipped the Fast Twitch (type2) muscle fibers become, because mitochondrial enzymes are enhanced.

Lactate shuttle: *mitochondrial enzymes burn lactate as a fuel aerobically, in heart, nerve, and ST muscle – also in FT muscle fibers that have been HIIT trained.*

Notice how much more energy (ATP) is produced aerobically!!!



Details are not important. The only purpose of this chart is to show the metabolic efficiency gained when FT fibers are trained by High Intensity Intervals (HIIT)

The basis for training the 1980 Olympic Team

Brooks understood what every player knows:

Hockey conditioning must ultimately be done on ice.

Forget Hollywood's mischaracterization of 'Herbies' as *THE* conditioning plan. Yes, players skated the lines when the coach wanted to catch their attention, and that occurred often. The *REAL* plan (laid out on his deck in the summer) called for high tempo/high skill practices each lasting as long as a game.

This was the only way to prepare for the Soviets, whose comfort zone seemed super-human if you hadn't prepared.



Overspeed practice …

is the execution of skills, decisions, and skating at a pace faster than comfortable, so in games this is your new elevated comfort zone.

The puck can be an anchor, because of the difficulty of executing skills and decisions at high speed, so coaches have to PUSH the tempo.

Brooks was a master at this. Skating behind the flow, he prodded incessantly for two hours. He knew, " If players practice skills in their own comfort zone it will not be elevated."

Overspeed meant practicing in Herb Brooks' comfort zone

The origin of "Overspeed training"

Herb knew – as did every player who opposed the Soviets in the decades from the 1950's to the 1990's – how fast the pace was in games against that dreaded machine in their old, faded red uniforms.

"You were never comfortable," Brooks said as we built his deck in the summer of 79 to plan the preparation months before the 1980 Olympics.

"When you start with the 20 best college players in the country, you know they're very comfortable at the pace of a college game … but they would not be comfortable against the Soviets."

Therefore, "conditioning" meant that all skills had to be rehearsed at an uncomfortable (overspeed) pace – over and over for two hours a day, six or seven days a week for six months.



Herb privately hoped people would remember him as an Olympic player, not just a coach. As the last man cut before the 1960 Olympics, it hurt as he sat with his father to watch TV coverage of the Gold Medal performance. As it ended, Herb Sr. said, "Looks like they cut the right people, son. Better bounce back." Brooks was determined it would never happen again, and went on to play in the 1964 and '68 Winter Olympics.

"It's a feeling, Cardiac, not physiology 101. You can't find it in your damn text book."



Overspeed

Conditioning

Building Windup machines

Hockey Conditioning?

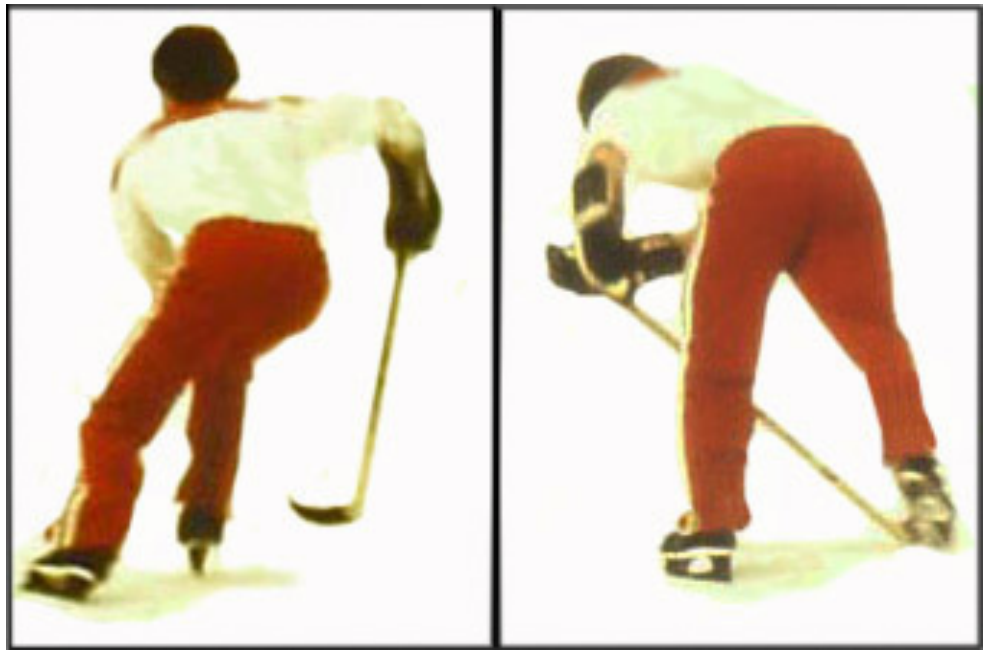
Consider the HABITS you program into the nerves.

Think Quality not Quantity training, especially with young athletes.

The goal is to 'CONDITION' the nervous system as Pavlov would to execute high quality skills – OverSpeed for an entire game.

Skating the lines programs your team to repeat slowness, as shown below.

For children and adolescent hockey players, endurance should always be a by-product of well-planned interval practices.



Perfect posture ***Slowness practice***

<--- 15 seconds --->

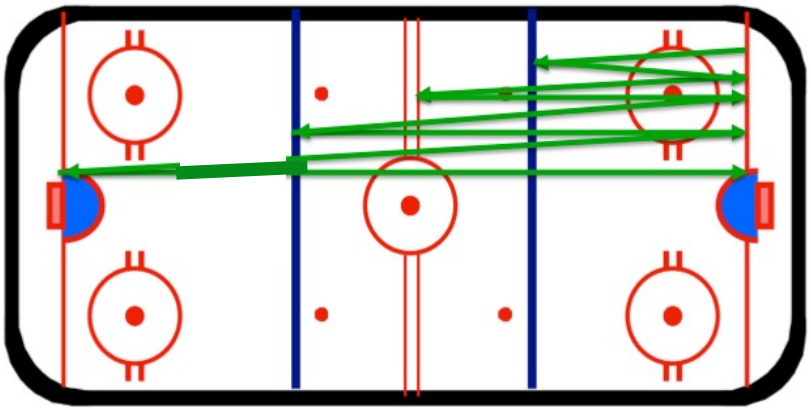
Repetitions don't automatically improve skill, speed, or stamina if that's our stated objective.

In fact, it has nothing to do with our stated objective.

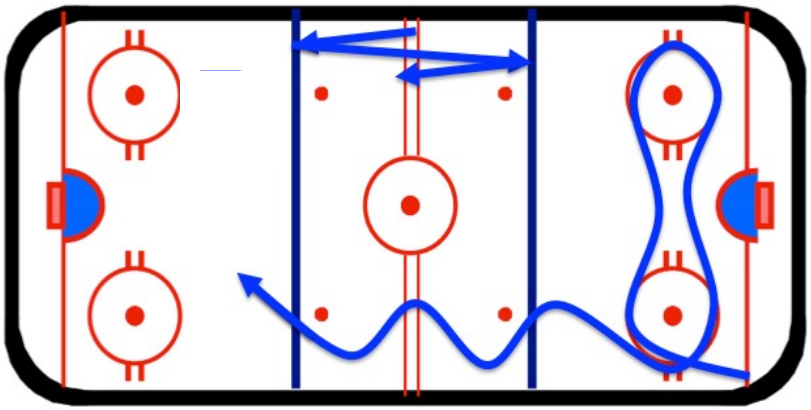
The quality of repetitions is all that matters.

Near the end of practice, you have a choice.

As stick skills, decisions, and concentration deteriorate, if you want to extend speed-endurance training, the choices are one of the two below …



(A) Traditional (counterproductive) choice:
45-second stop-start torture drills that promote slowness and poor skating habits for the last 35 seconds of the 45.



(B) OverSpeed intervals: 6-10 second drills with or without pucks, decisions, and stick skills. It builds endurance, speed, quickness, and agility. These are just samples. More in the appendix.

In an Overspeed practice no single drill develops hockey-endurance. It is the sum of all drills — just like the endurance needed in a game!

Repetitions change the Nervous System

Two photos from video of a player during a stop-start endurance test demonstrate the effects of fatigue in 28 seconds (between these two video frames). On the left he is near the start of the first length; at right, the same position on the ice, starting the fifth length (notice the circle on the ice).

Bottom line? His acceleration (red vector) is 60% slower

Why? Knee bend on the first length, allows him to lean more, producing longer strides.

Also, his entire body is extended in a straight line (SLX, not Pike), so force passes through his center of mass. Therefore, whatever strength he has in his lower body is more efficient before fatigue.

What we can't see in a still photo is that stride rate is much slower.

In a failed attempt to train endurance, he's practicing slow feet and inefficient postural habits.

Don't do this to kids!!!

